

1. A method of making a flexibilized resorcinolic resin solutions, comprising

contacting one or more phenolic compounds with approximately 0.05 to 0.4 mole, per mole of the phenolic compound,

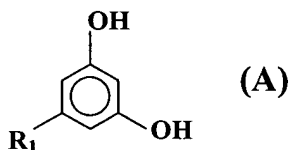
- (i) of an unsaturated dihydroxy compound; or
- (ii) of an unsaturated aliphatic aldehyde compound; or
- (iii) of an aliphatic dialdehyde compound; or
- (iv) of a mixture of (i), (ii), and (iii),

in the presence of an acid catalyst to obtain a reaction mixture,

contacting the reaction mixture with about 0.1 to about 0.6 mole of an aldehyde per mole of phenolic compound, the aldehyde being different from the unsaturated aldehyde and the aliphatic dialdehyde.

2. The method of claim 1, wherein the phenolic compound is selected from m-cresol, 3,5-dimethyl phenol, resorcinol, 5-methyl resorcinol, 5-ethyl resorcinol, 5-propyl resorcinol, m-amino phenol, 2-methyl resorcinol, 4-methyl resorcinol, 4-ethyl resorcinol, 4-propyl resorcinol, phloroglucinol, or a mixture thereof

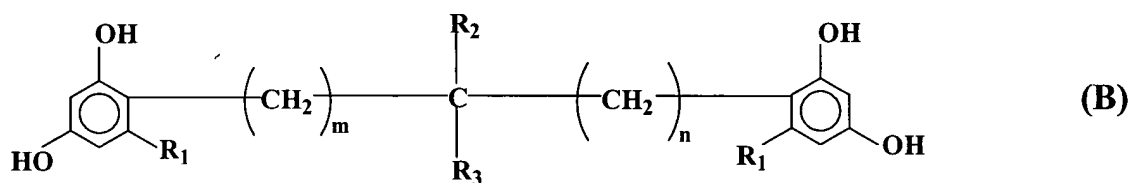
3. The method of claim 1, wherein the phenolic compound is represented by the following formula (A):



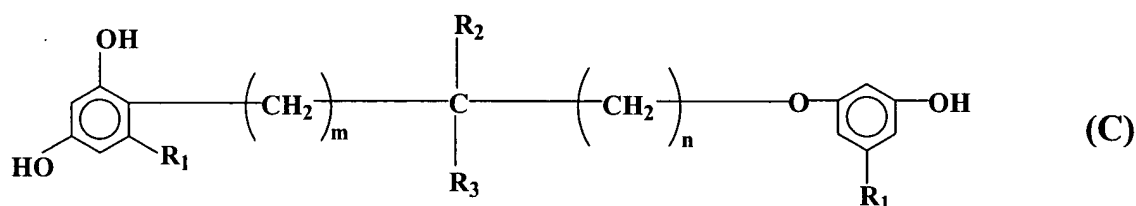
wherein R<sub>1</sub> represents a radical selected from the group consisting of hydrogen, hydroxyl and an alkyl radical having 1 to 3 carbon atoms.

4. The method of claim 1, wherein the acid catalyst is selected from oxalic acid, sulfuric acid, benzenesulfonic acid, benzenedisulfonic acid, p-toluenesulfonic acid, phosphoric acid, or a mixture thereof.

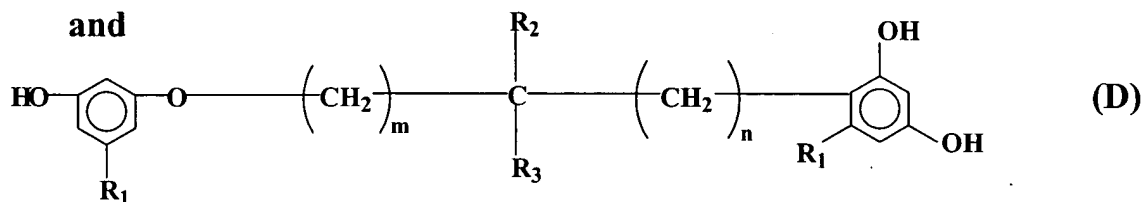
5. The method of claim 1, wherein the reaction mixture comprises at least one compound having an alkylene ether linkage.
6. The method of claim 1, wherein the contacting is carried out at a temperature in the range of between about 120° C and about 150° C.
7. The method of claim 1, wherein the unsaturated dihydroxy compound is 1,4-dihydroxy-2-butene.
8. The method of claim 1, wherein the reaction mixture comprises one or more compounds as represented by the following structures (B, C and D).



and



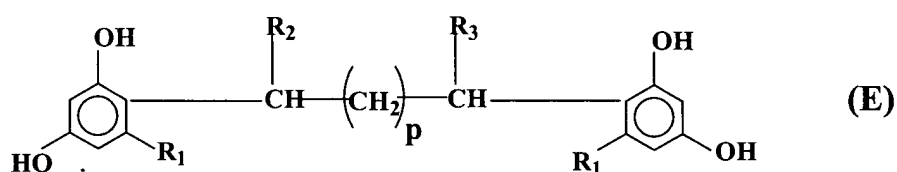
and



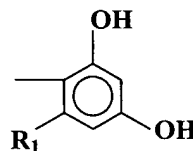
where  $\text{R}_1$  and  $\text{R}_2$  are independently  $-\text{CH}_3$ ,  $-\text{CH}_2\text{CH}_3$ , or  $-\text{CH}_2\text{CH}_2\text{CH}_3$  ;

and  $\text{R}_3$  is either  $-\text{H}$  or  $\begin{array}{c} \text{OH} \\ | \\ \text{C}_6\text{H}_3\text{R}_1 \\ | \\ \text{OH} \end{array}$  and  $m = 0, 1$  or  $2$  and  $n = 0, 1$  or  $2$ .

9. The method of claim 1, wherein the aldehyde is selected from the group consisting of formaldehyde, acetaldehyde, propionaldehyde, n-butyraldehyde, n-valeraldehyde, and a mixture thereof.
10. The method of claim 1, wherein the molar ratio of the phenolic compound to the unsaturated dihydroxy is between about 1:0.1 to about 1:0.3.
11. The method of claim 1, wherein the molar ratio of the phenolic compound to the aldehyde is between about 1:0.35 to about 1:0.45.
12. The method of claim 1, wherein the unsaturated aldehyde is selected from crotonaldehyde, arolein, methacrolein, or a mixture thereof.
13. The method of claim 1, wherein the dialdehyde compound is selected from the group consisting of malonaldehyde, succinaldehyde, glutaraldehyde, adipaldehyde, or a mixture thereof.
14. The method of claim 1, wherein the reaction mixture comprises a compound having the following structure.

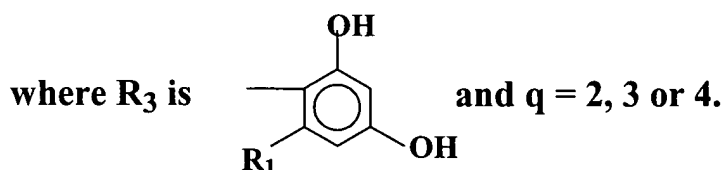
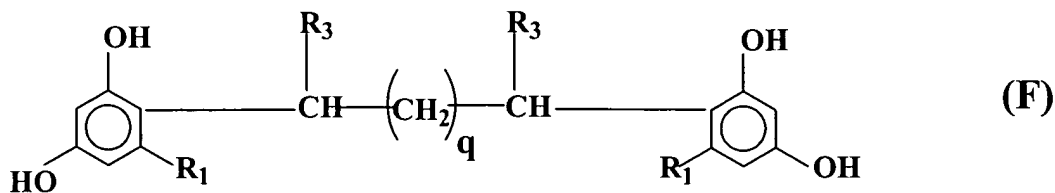


where  $R_1$  and  $R_2$  are as defined before and  $R_3$  is  
and  $p = 0$  or  $1$ .



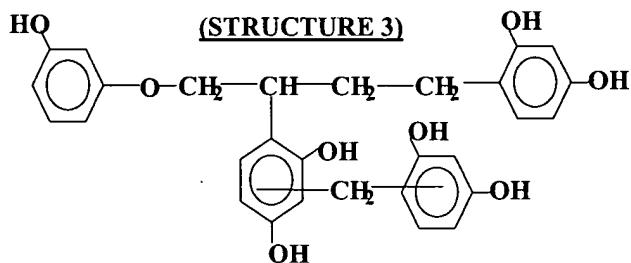
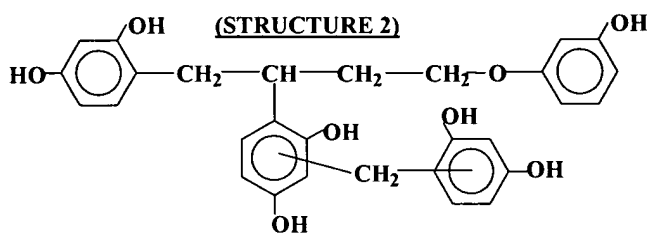
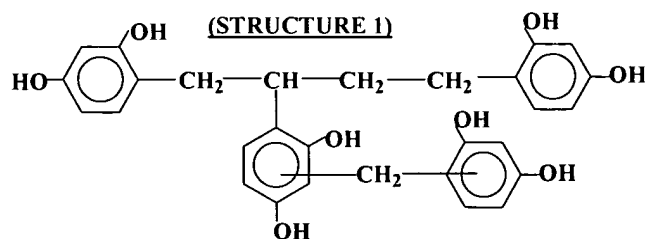
15. The method of claim 1, wherein the molar ratio of the phenolic compound to the unsaturated aldehyde is between about 1:0.1 to about 1:0.3.

16. The method of claim 1, wherein the reaction mixture comprises a compound having the following structure.

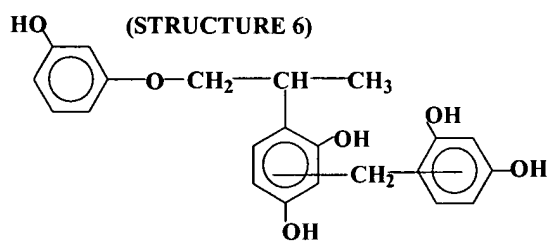
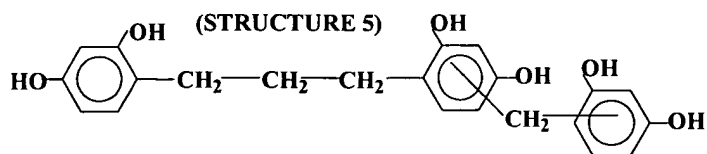
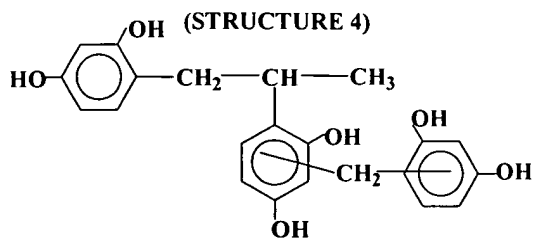


17. The method of claim 1, wherein the molar ratio of the phenolic compound to the dialdehyde is between about 1:0.05 to about 1:0.3.
18. An adhesive composition, comprising a flexibilized resorcinol resin prepared by the method of claim 1.
19. The adhesive composition of claim 18, wherein the adhesive composition is a single-step adhesive composition comprising an aqueous mixture of (a) the flexibilized resorcinol resin (b) a basic solution; (c) an aqueous formaldehyde solution; (d) a vinyl pyridine SBR copolymer latex; (e) water and (f) optionally one or more adhesion promoter additive compounds selected from the group consisting of blocked polyisocyanates, water soluble or dispersible aliphatic or aromatic epoxy compounds and organosilanes.
20. The adhesive composition of claim 19, further comprising an adhesive selected from the group consisting of polyepoxide compound and blocked polyisocyanates.
21. The adhesive composition of claim 20, wherein the blocked polyisocyanate compound is selected from addition reaction products of a polyisocyanate compound with a blocking agent comprising at least one member selected from caprolactam, phenolic compounds or oxime compounds.

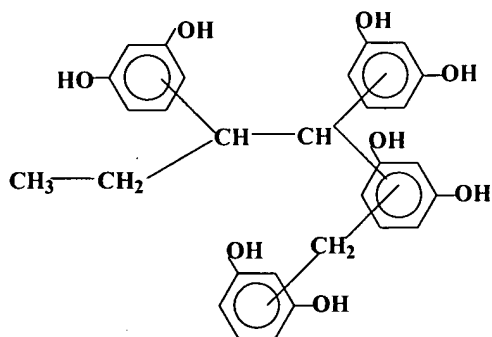
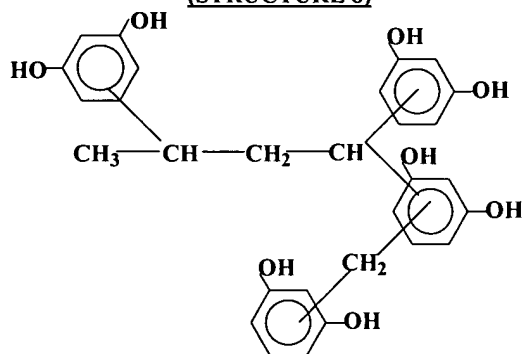
22. A flexibilized resorcinolic novolak resin, comprising one or more compounds represented by the following structures:



23. A flexibilized resorcinolic novolak resin, comprising one or more compounds represented by the following structures:



24. A flexibilized resorcinolic novolak resin, comprising one or more compounds represented by the following structures:

**(STRUCTURE 7)****(STRUCTURE 8)**

25. A flexibilized resorcinolic novolak resin, comprising a compound represented by the following structure:

**(STRUCTURE 9)**